(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 840 295 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.05.1998 Bulletin 1998/19

(51) Int Cl.[6]: **G11B 7/00**

(21) Application number: **97308591.3**

(22) Date of filing: **28.10.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV RO SI

(30) Priority: **31.10.1996 JP 289456/96**

(71) Applicant: **SONY CORPORATION**
Tokyo 141 (JP)

(72) Inventor: **Igarashi, Katsuji**
Shinagawa-ku, Tokyo 141 (JP)

(74) Representative: **Pratt, Richard Wilson et al**
D. Young & Co,
21 New Fetter Lane
London EC4A 1DA (GB)

(54) Initializing optical disc systems

(57) A system for initializing an optical disc player when reproduction of data from a side of a multilayer disc is desired. The initialization procedure involves determining one or more initialization values for a first layer of data on the side, storing the initialization values determined for the first layer, and repeating the determining and storing steps for the other layers on the side.

EP 0 840 295 A2

Printed by Jouve, 75001 PARIS (FR)

21.

The PLL circuit 17 generates a clock signal based upon the binary signal received from the RF equalizer and outputs both the clock signal and binary signal to a CLV (or "Constant Linear Velocity") circuit 13, a data decoder 18, and a jitter measuring unit 19.

The CLV circuit 13 generates a CLV control signal based upon the received clock signal and binary signal. The CLV control signal is coupled through a switch 31, and it is used to control the rotational speed of the disc such that speed at which data within a track crosses the optical pick-up beam is the same for each track on the disc - regardless of the radial position of the beam with respect to the disc's center. The disc is rotated by a spindle motor 12, and thus to implement constant linear velocity rotation, the switch couples the CLV control signal to the spindle motor 12.

An initial driving circuit 14 is provided for generating a non-CLV control signal. The non-CLV control signal is coupled to the spindle motor 12 by switch 31 as an alternative to the CLV control signal, and it causes the disc to rotate at a constant angular speed. The position of switch 31 is controlled by a control unit 11 (to be described in more detail below).

The data decoder 18 decodes the data read from the optical disc by processing the binary signal and clock signal received from the PLL circuit. The decoder then outputs the decoded data, and in addition outputs the address of the disc sector from which the data originated. For purposes of the present description, the decoder output is considered to be passed solely to the control unit; however, it should be noted that in practice the decoder output is passed to other circuit(s) as well.

The jitter measuring unit 19 measures the amount of jitter in the system through processing of the binary signal and clock signal. It outputs an indication of the jitter level to the equalizer coefficient setting/automatic adjustment unit 21, the focus offset setting/automatic adjustment unit 22, and a radial skew offset setting/automatic adjustment unit 26.

The equalizer coefficient setting/automatic adjustment unit's function during initialization is to calculate a coefficient value for each layer on the multilayer optical disc and to store the calculated coefficient values in an adjustment value storing unit 20. During reproduction of a particular disc layer, the equalizer coefficient unit is responsive to a layer indication signal, the unit receiving the stored coefficient corresponding to the layer being reproduced as indicated by the layer indication signal. The coefficient received by the equalizer coefficient unit is passed to the RF equalizer.

The focus offset setting/automatic adjustment unit's function during initialization is to calculate a focus offset adjustment value for each layer on the multilayer disc based on the jitter level received from the jitter measuring unit, and to store the calculated focus offset adjustment values in the adjustment value storage unit. During reproduction of a particular disc layer, the focus offset unit is responsive to the layer indication signal, the unit receiving the stored focus offset adjustment value corresponding to the layer being reproduced as indicated by the layer indication signal. The focus offset adjustment value received by the focus offset unit is passed to an adder 32.

The focus gain setting/automatic adjustment unit's function during initialization is to calculate a focus gain adjustment value for each layer on the multilayer disc based on the focus error signal received from the optical pick-up, and to store the calculated focus gain adjustment values in the adjustment value storage unit. During reproduction of a particular disc layer, the focus gain unit is responsive to the layer indication signal, the unit receiving the stored focus gain adjustment value corresponding to the layer being reproduced as indicated by the layer indication signal. The focus gain adjustment value received by the focus gain unit is used by the unit to amplify the focus error signal. The amplified focus error signal generated by the focus gain unit is passed to adder 32.

The adder 32 simply adds the focus offset adjustment value received from the focus offset unit to the amplified focus error signal received from the focus gain unit and outputs the sum to a focus servo circuit 4.

The focus servo circuit 4 is turned on and off by a focus servo control signal from the control unit 11. When turned on, the focus servo circuit generates a focus coil control signal in response to the sum received from adder 32. The focus coil control signal controls adjustment of the optical pick-up's focus position through a focus coil 3. Thus, for example, the focus coil moves an objective lens of the optical pick-up to change the focus position of the pick-up in accordance with the focus coil control signal received from the focus servo circuit.

The tracking offset setting/automatic adjustment unit's function during initialization is to calculate a tracking offset adjustment value for each layer on the multilayer disc based on the tracking error signal received from the optical pick-up, and to store the calculated tracking offset adjustment values in the adjustment value storage unit. During reproduction of a particular disc layer, the tracking offset unit is responsive to the layer indication signal, the unit receiving the stored tracking offset adjustment value corresponding to the layer being reproduced as indicated by the layer indication signal. The tracking offset adjustment value received by the focus offset unit is passed to an adder 33.

The tracking gain setting/automatic adjustment unit's function during initialization is to calculate a tracking gain adjustment value for each layer on the multilayer disc based on the tracking error signal received from the optical pick-up, and to store the calculated tracking gain adjustment values in the adjustment value storage unit. During reproduction of a particular disc layer, the tracking gain unit is responsive to the layer indication signal, the unit receiving the stored tracking gain adjustment value corresponding to the layer being reproduced

justment values based on the jitter level received from the jitter measuring unit and stores the determined values. Since the radial skew is the same for each layer in the disc, radial skew offset adjustment value determination is performed only once, and is not repeated for each layer.

At step S48, the focus offset setting/automatic adjustment unit determines a focus offset adjustment value for layer 0 based on the jitter level received from the jitter measuring unit. More specifically, the focus offset unit varies the focus position of the optical pick-up within a predetermined range of focus positions and sets the focus offset adjustment value according to the focus position where the jitter level is minimized. The determined focus offset adjustment value is stored in the adjustment value storage unit as the variable "FCS_OFFO".

Fig. 5 shows how the focus offset adjustment value is determined. Initially, the focus offset value is set to "0" and the jitter value corresponding to the "0" offset (point A) is stored. The focus offset value is then varied about "0" in both the positive and negative directions in order to determine the point of minimum jitter (point B).

Once the offset corresponding to minimum jitter is determined, the offset is increased (positive direction) from the value corresponding to minimum jitter to a "positive displacement offset value", at which the jitter has increased to a predetermined level above the minimum jitter (point C), and the positive displacement offset value is saved. Next, the offset is decreased (negative direction) from the value corresponding to minimum jitter to a "negative displacement offset value", at which the jitter has once again increased to a predetermined level above the minimum jitter (point D), and the negative displacement offset value is saved.

Finally, the positive displacement offset value and negative displacement offset value are averaged to determine the focus offset adjustment value (point E, or "Bias Point"), which will be used during reproduction.

Computing the focus offset adjustment value in this manner, rather than by simply setting the offset to the value at which the jitter appears minimum (point B), provides for a system that is more error tolerant. For example, interference in the form of dust particles on the disc may prevent determination of the jitter minimum point to within an acceptable tolerance; whereas the above-described averaging technique will mitigate the effect of such interference and thereby allow determination of a bias point that is within acceptable tolerance.

Referring back to Figs. 2A and 2B, at step S49, the equalizing coefficient setting/automatic adjustment unit computes an equalizer coefficient by varying the coefficient within a predetermined range and observing the jitter that results in the reproduced RF signal. The coefficient that results in the lowest jitter level is the coefficient that will be used in reproduction of layer 0, and it is stored in the adjustment value storing unit as "EQ_COEF0".

At step S50, the focus gain setting/automatic adjustment unit calculates the focus gain adjustment value for layer 0 based on the focus error signal received from the optical pick-up, and stores the calculated focus gain adjustment value in the adjustment value storage unit as "FCS_GAIN0".

At step S51, the tracking gain setting/automatic adjustment unit calculates the tracking gain adjustment value for layer 0 based on the tracking error signal received from the optical pick-up, and stores the tracking gain adjustment value in the adjustment value storage unit as "TRK_GAIN0".

At step S52, the content of a predetermined disc address is read, and from the content at the disc address a determination is made as to whether or not the optical pick-up was focused on layer 0 during execution of steps S45-S51. If it is determined that the pick-up was not focused on layer 0 during execution of steps S45-S51; step S53 is executed, that is, the tracking servo circuit and sled servo circuit are turned off, switch 31 is directed to couple the initial drive circuit to the spindle motor, the focus position of the optical pick-up is set to layer 0, and steps S45-S51 are repeated. On the other hand, if it is determined at step S52 that the pick-up was focused on layer 0 during the original execution of steps S45-S51, the process proceeds to step S54.

At step S54, the tracking servo circuit and sled servo circuit are turned off, switch 31 is directed to couple the initial drive circuit to the spindle motor, and the focus position of the optical pick-up is set to layer 1.

At step S55, a tracking offset adjustment value is determined in the same manner in which it was determined in step S45, however the value determined in step S55 is stored as the tracking offset adjustment value for layer 1 (i.e. "TRK_OFF1").

At step S56, the control unit turns on the tracking servo circuit and the sled servo circuit, and causes switch 31 to couple the CLV circuit to the spindle motor.

At step S57, a focus offset adjustment value is determined in the same manner in which it was determined in step S48, however the value determined in step S57 is stored as the focus offset adjustment value for layer 1 (i.e. "FCS_OFF1").

At step S58, an equalizer coefficient is determined in the same manner in which it was determined in step S49, however the coefficient determined in step S58 is stored as the coefficient for layer 1 (i.e. "EQ_COEF1").

At step S59, the focus gain adjustment value is determined in the same manner in which it was determined in step S50, however the value determined in step S59 is stored as the focus gain adjustment value for layer 1 (i.e. "FCS_GAIN1").

At step S60, the tracking gain adjustment value is determined in the same manner in which it was determined in step S51, however the value determined in step S60 is stored as the tracking gain adjustment value for layer 1 (i.e. "TRK_GAIN1").

At step S61, the content of a predetermined disc address is read, and from the content at the disc address

7. The method according to claim 6, wherein said focus offset adjustment value is set according to a miminum jitter level.

8. The method according to claim 1, wherein said at least one initialization value is a focus gain adjustment value.

9. The method according to claim 1, wherein said at least one initialization value is an equalizer coefficient

10. An apparatus for initializing an optical disc player prior to reproducing data from a side of a multilayer optical disc comprising:

means for determining at least one initialization value for a first layer of data on said side;
means for storing said at least one initialization value for use in reproducing at least a portion of said first layer of data; and
means for repeating said steps of determining and storing for the remaining layers on said side of said disc

11. The apparatus according to claim 10, wherein said means for determining and said means for storing operate on said layers according to a predetermined sequence of layers.

12. The apparatus according to claim 10, wherein said at least one initialization value is a tracking offset adjustment value.

13. The apparatus according to claim 12, wherein said tracking offset adjustment value is set to a value that causes a DC component of a tracking error signal to be canceled

14. The apparatus according to claim 10, wherein said at least one initialization value is a tracking gain adjustment value.

15. The apparatus according to claim 10, wherein said at least one initialization value is a focus offset adjustment value.

16. The apparatus according to claim 15, wherein said focus offset adjustment value is set according to a minimum jitter level.

17. The apparatus according to claim 10, wherein said at least one initialization value is a focus gain adjustment value.

18. The apparatus according to claim 10, wherein said at least one initialization value is an equalizer coefficient.

19. An apparatus for initializing an optical disc player prior to reproducing data from a side of a multilayer optical disc, comprising:

at least one initialization value setting unit for determining at least one initialization value for a first layer of data on said side and at least one initialization value for a second layer of data on said side; and
an adjustment value storing unit for storing said initialization values for use in reproducing at least a portion of said first layer of data and at least a portion of said second layer of data.

20. The apparatus according to claim 19, wherein said at least one initialization value setting unit and said adjustment value storing unit operate on said layers in a predetermined order.

FIG. 2A

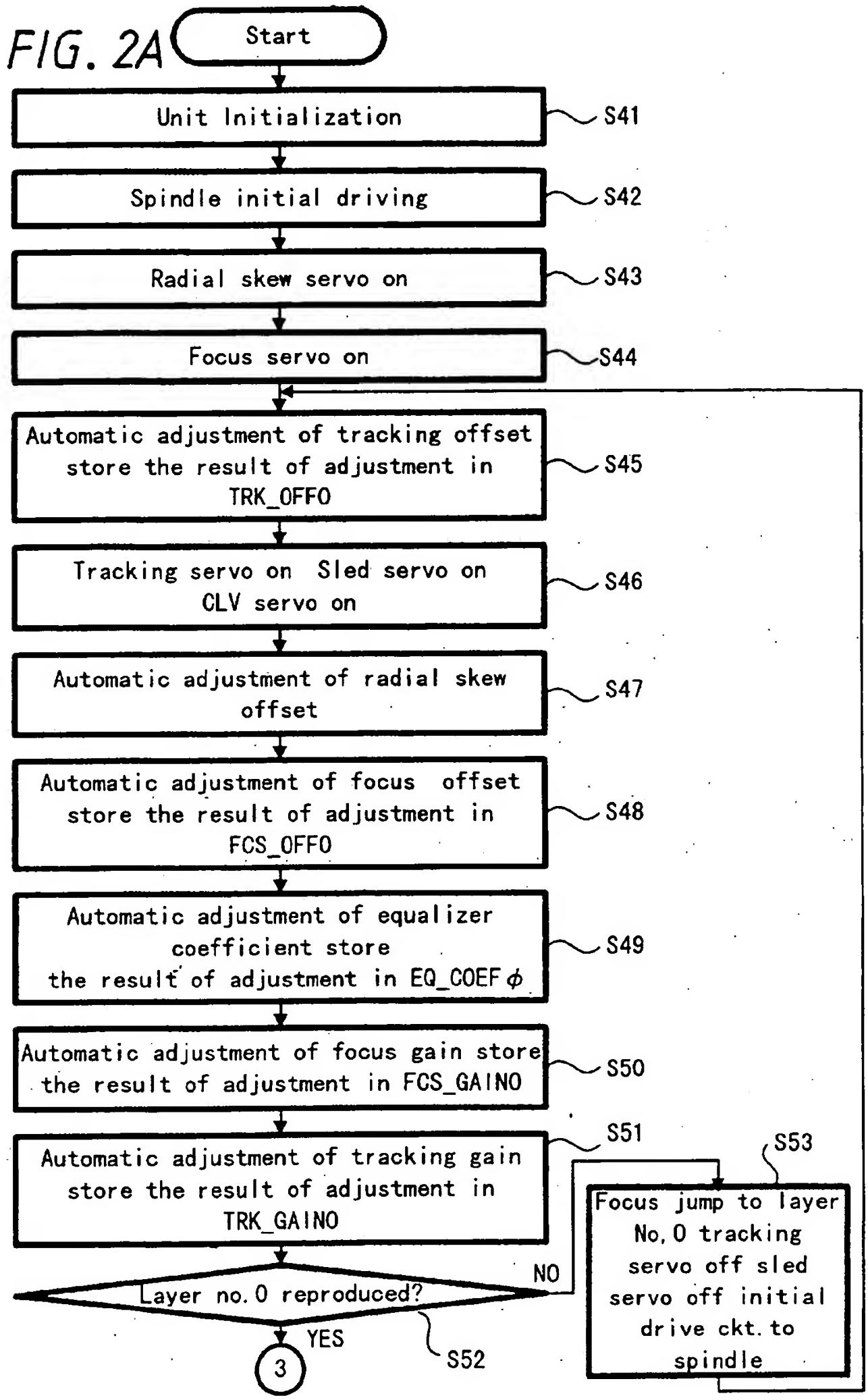


FIG. 3A

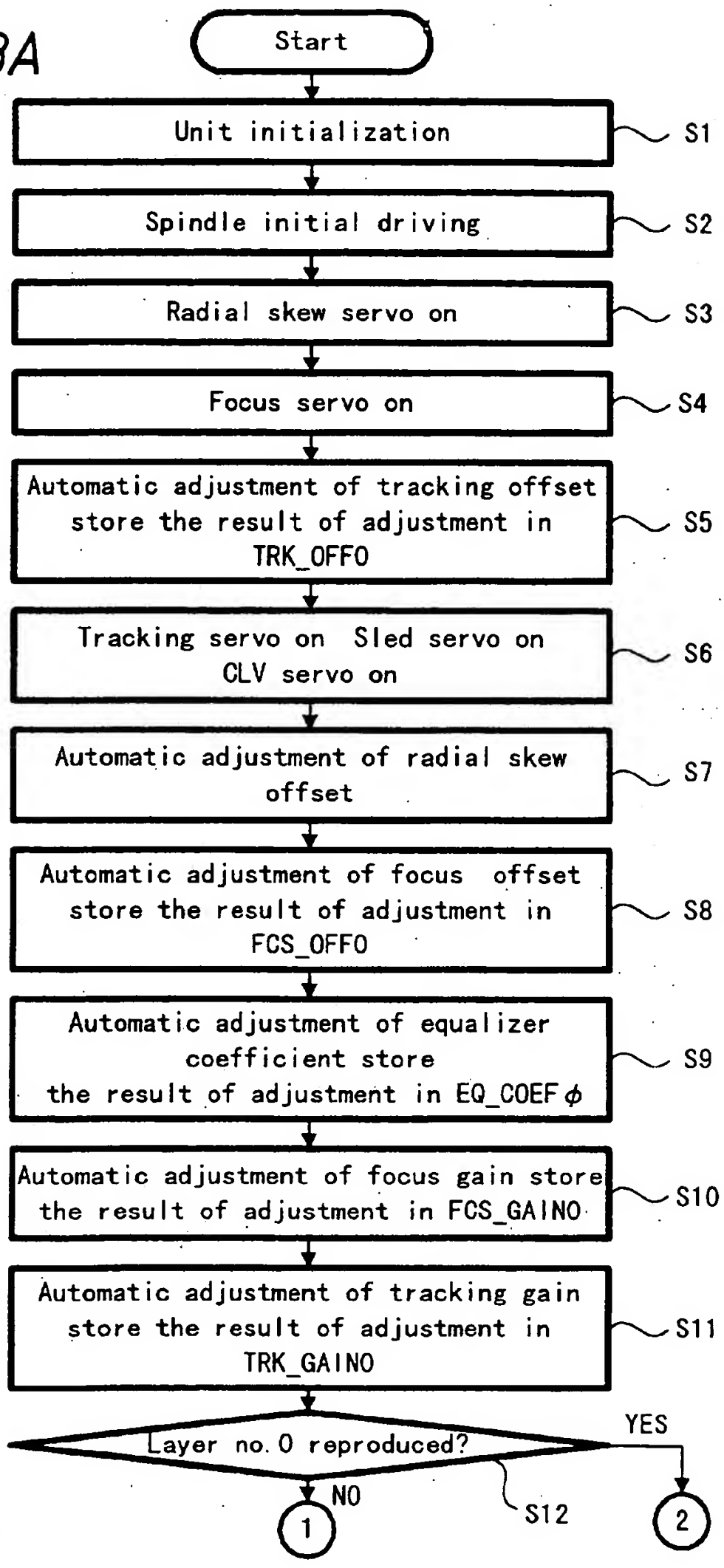
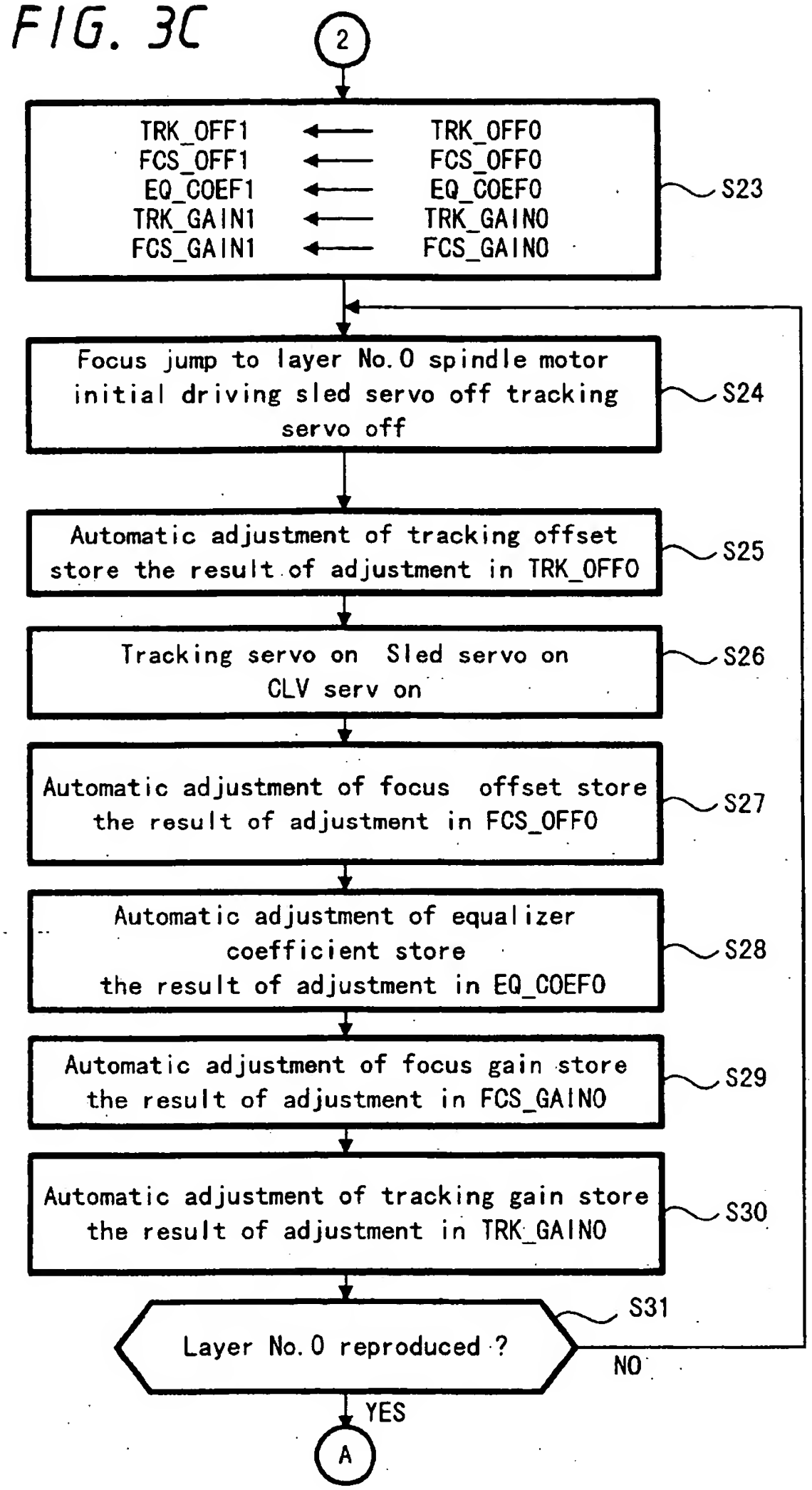


FIG. 3C



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 840 295 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
15.12.1999 Bulletin 1999/50

(43) Date of publication A2:
06.05.1998 Bulletin 1998/19

(21) Application number: **97308591.3**

(22) Date of filing: **28.10.1997**

(51) Int Cl.[6]: **G11B 7/00**, G11B 7/09

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV RO SI

(30) Priority: **31.10.1996 JP 28945696**

(71) Applicant: **SONY CORPORATION**
Tokyo 141 (JP)

(72) Inventor: **Igarashi, Katsuji**
Shinagawa-ku, Tokyo 141 (JP)

(74) Representative: **Pratt, Richard Wilson et al**
D. Young & Co,
21 New Fetter Lane
London EC4A 1DA (GB)

(54) Initializing optical disc systems

(57) A system for initializing an optical disc player when reproduction of data from a side of a multilayer disc is desired. The initialization procedure involves determining one or more initialization values for a first layer of data on the side, storing the initialization values determined for the first layer, and repeating the determining and storing steps for the other layers on the side.

EP 0 840 295 A3

Printed by Jouve, 75001 PARIS (FR)

BNSDOCID: <EP___0840295A3_I_>

European Patent Office

Application Number
EP 97 30 8591

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 97 30 8591

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-10-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0724256 A	31-07-1996	JP 8203107 A	09-08-1996
		JP 9147391 A	06-06-1997
		US 5612939 A	18-03-1997
		US 5808989 A	15-09-1998
US 5499231 A	12-03-1996	NONE	
EP 0749117 A	18-12-1996	JP 9007193 A	10-01-1997
		CN 1147180 A	09-04-1997
		US 5751675 A	12-05-1998
		US 5808983 A	15-09-1998
EP 0609882 A	10-08-1994	JP 6231477 A	19-08-1994
		US 5475664 A	12-12-1995
EP 0807926 A	19-11-1997	JP 9305988 A	28-11-1997
		JP 9326126 A	16-12-1997
		CN 1175057 A	04-03-1998
EP 0767455 A	09-04-1997	JP 9106617 A	22-04-1997
		US 5790493 A	04-08-1998
JP 08185636 A	16-07-1996	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82